NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Wednesday, January 16, 2019 9:28 AM
To: Request for Additional Information
Cc: Lee, Samuel; Dudek, Michael; Lavera, Ronald; Tesfaye, Getachew; Chowdhury, Prosanta; NuScaleDCRaisPEm Resource
Subject: Request for Additional Information No. 515 eRAI No. 9607 (12.02) REVISION 1
Attachments: Request for Additional Information No. 515 (eRAI No. 9607) REV 1.pdf

REVISED: PLEASE DISREGARD PREVIOUS SUBMITTAL SENT ON JANUARY 14, 2019.

Attached please find NRC staff's REVISED request for additional information (RAI) concerning review of the NuScale Design Certification Application.

Please submit your technically correct and complete response by March 14, 2019, to the RAI to the NRC Document Control Desk.

If you have any questions, please contact me.

Thank you.

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Request for Additional Information No. 515 (eRAI No. 9607) REV 1

Issue Date: 01/14/2019
Application Title: NuScale Standard Design Certification - 52-048
Operating Company: NuScale Power, LLC
Docket No. 52-048
Review Section: 12.02 - Radiation Sources
Application Section: 12.2

QUESTIONS

12.02-34

As a follow-up RAI to RAI 9257, Question 12.02-14, the staff is requesting additional information on the crud burst model used for the development of the DCA submittal.

Basis:

10 CFR 52.47(a)(5) requires applicants to identify the kinds and quantities of radioactive materials expected to be produced in the operation and the means for controlling and limiting radiation exposures within the limits set forth in part 20 of this chapter.

Criterion 61—"Fuel storage and handling and radioactivity control," requires systems which may contain radioactivity to be designed with suitable shielding for radiation protection and with appropriate containment, confinement, and filtering systems.

DSRS Section 12.3-12.4 states that, "The areas inside the plant structures, as well as in the general plant yard, should be subdivided into radiation zones, with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified.

Background:

The applicant's response to RAI-9257, Question 12.02-14, dated 8 August 2018 (ADAMS Accession No. ML18220B407), stated that the crud burst model used for the development of DCD Revision 0, Tier 2, was based on using relevant industry operating information as described in EPRI Technical Report 1011106, "Proceedings of the June 2004 EPRI PWR Primary Shutdown Workshop." This EPRI report utilized data from several large PWRs, including some with high duty core indexes, from which NuScale selected the highest reported values on which to base its model.

The staff reviewed the referenced EPRI report, and agrees that the crud burst factors, as derived from the information contained in the report, satisfies the staff concerns with respect to consideration of significant crud bursts related to a HDCI. The radioactive material contents for CVCS demineralizers and filters contained in DCA Revision 1, Tier 2, were based on the expected accumulation of radioactive material (e.g., CVCS Mixed Bed Demineralizer 489 Ci of Co-58) resulting from a crud burst of a power adjusted magnitude consistent with the operating experience described in TR-1011106. Therefore, the staff found the crud burst peaking factor assumptions provided in DCA Revision 1, Table 12.2-6, "Chemical and Volume Control System Component Source Term Inputs and Assumptions," to be acceptable.

However, NuScale further stated in the same response to RAI-9257 that they had decided to remove the radionuclide activity from an assumed crud burst transient condition from the Chemical and Volume Control System (CVCS) design basis evaluation because NuScale indicated that the crud burst assumption was unnecessarily conservative. Therefore, NuScale removed the crud burst peaking factor information from Table 12.2-6 and recalculated source terms without the assumed crud burst (this will subsequently lead to lower calculated dose rates). NuScale stated that instead of using the assumed crud burst peaking factor they will utilize the guidance of American National Standards Institute/American Nuclear Society (ANSI/ANS), Standard 18.1-1999, "Source Term

Specification," for crud isotopes, as recommended in NuScale DSRS Section 11.1. NuScale also stated that the CVCS mixed bed demineralizers are assumed to collect radionuclide activity from the primary coolant during the operating cycle and for a short post shutdown period, but with no additional radionuclide inventory from an assumed additional crud burst.

The staff reviewed the basis for ANSI/ANS 18.1 to assess the applicability of ANSI-18.1 for evaluating the contributions from crud bursts on coolant radioactivity concentrations and the subsequent accumulation of radioactive material in systems such as the CVCS and Radioactive Waste systems. The basis documents for the development of ANSI/ANS 18.1 includes NUREG-CR-1992 "In-Plant Source Term Measurements at Four PWR's." NUREG-CR-1992 Section 2.3 "Measurement Results," states that in all cases, only measurements obtained during non-spiking periods when the reactor power was 75% or higher were included in the averages. NUREG-CR-1992 Section 2.4 "Comparisons with Predictions," states that ANSI/ANS-18.1 provides typical radionuclide concentrations for use in estimating the average radioactivity in reactor coolant water. Therefore, the staff believes that while ANSI/ANS-18.1 is a valid reference for estimating the coolant concentrations for routine releases from nuclear power plants, it is not appropriate for determining the coolant concentrations associated with shutdown crud bursts. These positions of the staff were discussed with NuScale representatives at a public meeting (ADAMS Accession No. - ML18327A104).

As a result of this change by NuScale the corrosion product inventory assumed in some of the CVCS system components (e.g., the Mixed Bed (MB) demineralizer) decreased significantly. For example, the Co-58 content of the CVCS Mixed Bed Demineralizer decreased from 489 Ci to 9.1 Ci. The reduction in corrosion products assumed to be present in the CVCS components significantly reduces the assumed dose rates from those components. Based on analysis performed by the staff, the dose rate from the CVCS MB using NuScale's proposed source term is over a factor of 3 less than the dose rate from the CVCS MB source term with 0.066% Failed Fuel with a crud burst included. An additional analysis by the staff indicates that the dose rate from the CVCS MB from a crud burst only (no other activity in the CVCS MB) is over 2 times higher than the dose rate from the CVCS MB demineralizer using the isotopic concentrations provided in the response to RAI 9257.

Since crud burst alone appears to be more radiologically significant than the non-crud burst source term, staff cannot reach a finding that the kinds and quantities of radioactive material have been appropriately identified, in accordance with 10 CFR 52.47(a)(5), without consideration of crud burst in the application.

Staff is providing the following changes as an example of a set of modifications to the DCD that would be appropriate to resolve staff concerns regarding 10 CFR 52.47(a)(5) compliance (note that this information is only provided as an example. If the applicant choses to follow a similar approach, they must ensure that the information and data provided are appropriate for the current application):

- Modify DCD Table 12.2-7, "Chemical and Volume Control System Component Source Terms – Radionuclide Content" to include a note that states the following:
    - The crud burst factors and the associated radioactive material content in the CVCS mixed bed demineralizer are presented in Table 12.2-7b.
- Modify DCD Table 12.2-7 and Table 12.2-8, "Chemical and Volume Control System Component Source Terms – Source Strength" to include a note that states the following:
    - These source terms and associated analyses do not include short-term transients such as crud bursts associated with refueling outages or are representative of the radiological content of components used to clean up crud bursts that have been stored for a time sufficient for the residual principle gamma emitters to be a small portion of the total activity.
- Include a new table in the DCD, Table 12.2-7b, as follows:

Table 12.2-7b: Crud Burst Peaking Factors and CVCS Mixed Bed Crud Radioactivity Content

Peaking factor due to crud burst:	Peaking Factor	
Co-58	10,000	
Other radionuclides	1,000	

Crud Isotopes	Activity in Mixed Bed (Ci) from just Crud Burst	Total Activity in Mixed Bed (Ci) following Crud Burst Cleanup (sum of normal operation plus crud burst cleanup)
Na24	655.4	656.0
Cr51	32.8	35.2
Mn54	18.3	29.4
Fe55	14.4	27.5
Fe59	3.2	3.6
Co58	479.9	489.0
Co60	6.4	12.9
W187	32.0	32.1
Zn65	5.8	8.8

Questions:

In order for staff to reach a regulatory conclusion with respect to 10 CFR 52.47(a)(5) please update the DCD to provide the appropriate crud burst information.